

IMCA-CAT

Environment, Safety, and Health Plan

Submitted: 2005 April 04

Revised: 2005 May 12

Submitted by: Lisa J. Keefe, Director

[Signature]

[Date]

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Section 1 IMCA-CAT Safety Policies

1.0 Purpose

IMCA-CAT is committed to ensuring that all sector activities are conducted in a safe and environmentally sound manner. This plan describes the sector's safety program which is implemented to fulfill this commitment.

1.1 Scope

To ensure that all IMCA-CAT activities are conducted in a safe and environmentally sound manner, this plan defines:

- 1) the standards to be followed by IMCA-CAT, and
- 2) the responsibilities within IMCA-CAT organization.

1.2 References

All activities at Argonne National Laboratory - East (ANL-E) will conform to the requirements of the documents listed below, except as provided for by variances or APS procedures. All of the following are available through the IMCA-CAT Safety Coordinator:

- ANL-E Environment, Safety, and Health Manual
- APS User Policies and Procedures
- ANL-E Hoisting and Rigging Manual
- ANL-E Transportation Safety Manual
- ANL-E Waste Handling Procedures Manual

1.3 General Policies

1. Failing to conform with this plan may result in sanctions and/or the loss of access to the APS and IMCA-CAT facilities.
2. Any person has the authority to stop activities that are unsafe or environmentally unsound. In addition, IMCA-CAT acknowledges that the APS has the authority to order a halt to sector activities that the APS, or other entities with oversight responsibilities, deem unsafe or not in compliance with requirements.
3. IMCA-CAT will comply with current version of the APS Policy and Procedure for configuration control of shielding systems. No safety system under configuration control is to be modified without IMCA-CAT and APS approval. (Refer to the APS User Policies and Procedures for the complete policy and procedure).

4. IMCA-CAT will cooperate with the APS to facilitate the oversight responsibilities of the APS, ANL and the DOE.
5. IMCA-CAT will implement an experiment safety review program. The program will be kept current with the relevant APS policies and procedures, including those set forth in Technical Updates, User Policies and Procedures, and AOD Division Director memoranda covering the subject.
6. Experimenters shall identify to IMCA-CAT the potential hazards associated with their activities and hazardous materials to be used in experiments at the APS (via the APS Experiment Safety Assessment Form (ESAF), and no experiment shall proceed without a CAT and APS approved ESAF and posted APS Experiment Authorization Form (ESA) and Experiment Hazard Control Plan (EHCP).
7. New or modified equipment and un-reviewed activities must be approved by the IMCA-CAT Director, or designee, prior to energizing the equipment or the start of work. Before any change in IMCA-CAT's operations that might reasonably be thought to increase the risk of significant adverse impact on the APS facilities, the environment or any person, is begun, the CAT will obtain the written approval of the APS Operations Division Director, or designee.
8. IMCA-CAT will maintain a list of current safety assignments (Appendix A) and will update this plan to keep it consistent with scope of CAT activities. The assignment list will be reviewed at least annually and the plan biannually with updates provided to the APS User Safety Officer.

1.4 IMCA-CAT Specific Policies

A. IMCA-CAT Sector Orientation

1. IMCA-CAT staff will provide its own Sector Orientation (refer to Appendix C.1) to all staff members and users, in accordance with the APS Policy and Procedure for Sector Specific Training.
2. Included in IMCA-CAT's Sector Orientation is a complete orientation to the Biochemistry Laboratory (refer to Appendix C.2).
3. Sector Orientation will be given to all staff and users, after their arrival at the sector and before the start of their work, if one of the following is applicable:
 - a. User is a new user of the IMCA-CAT facility
 - b. It has been two years since the user's last Sector Orientation
 - c. User is a General User, for whom sector orientation is given at each visit to IMCA-CAT
 - d. Any significant changes have been made to the IMCA-CAT facilities, policies, or procedures since the user's last visit to the sector

B. IMCA-CAT staff members and users, when working with heavy-atom reagents, will follow the 'IMCA-CAT Standard Operating Procedure for Derivatization of Macromolecular Crystals with Heavy-atom Reagents' (refer to Appendix C.3).

C. IMCA-CAT will follow the Electrical Safety policies of Chapter 9 of the ANL ES&H manual and APS TU-13, as well as the most recent APS User Safety Update regarding Electrical Safety, issued on 16 February 2005. These policies and procedures will be followed with all electrical equipment, both permanent and temporary, used at IMCA-CAT.

Section 2 - CAT Safety Organization & Responsibilities

The IMCA-CAT **Director** has line responsibility for safety for all sector activities at ANL and for ensuring that this plan is implemented. The Director is also responsible for evaluating and responding in a graded manner to noncompliance with this plan.

The IMCA-CAT **Safety Coordinator** reports to the sector Director and is responsible for implementing and overseeing conformance with this safety plan. The Safety Coordinator is to ensure that the sector has access to the ANL-E ESH Manual and the other identified standards and to assist sector staff, CAT members, and users in meeting the requirements of these standards.

The IMCA-CAT **Electrical Safety Coordinator** is appointed by the sector Director and is responsible for electrical safety and ensuring compliance with ANL electrical safety standards in all of the sector's facilities. The Electrical Safety Coordinator is to be knowledgeable of ANL-E ESH Manual defined electrical safety requirements and must remain current in ANL General Electrical Safety Training, Lockout/Tagout Training, and NFPA70E (or equivalent) training.

The IMCA-CAT **Chemical Safety Coordinator** is appointed by the sector Director and is responsible for chemical safety, including chemical waste management and ensuring compliance with ANL and OSHA chemical safety standards in all of the sector's facilities. The Chemical Safety Coordinator is also responsible for the sector's proper use of the ANL Chemical Management System. The Chemical Safety Coordinator is to be knowledgeable of ANL-E ESH Manual defined chemical safety requirements and must remain current in Chemical Waste Certification, Chemical Waste Generator Training, Safe Handling of Carcinogens Training, Personal Protective Equipment Training, Cryogenic Safety Training, Hazard Specific Training, and any other relevant chemical safety training.

The IMCA-CAT **Transportation Safety Coordinator** is appointed by the sector Director and is responsible for overseeing the safe transportation of materials to and from the sector and ensuring compliance with ANL transportation safety standards. The Transportation Safety Coordinator is to be knowledgeable of ANL transportation requirements as it pertains to APS-specific shipping and receiving requirements. The Transportation Safety Coordinator will remain current in the relevant APS transportation safety training courses.

The IMCA-CAT **BioSafety Coordinator** is appointed by the sector Director and is responsible for tracking all biological samples that are stored or being used at the sector and ensuring the safe disposal of those samples that are no longer in use. The BioSafety Coordinator is also responsible for assisting in formulating, implementing, and administering all sample-handling procedures. In particular, the BioSafety Coordinator will ensure that samples and reagents brought to the sector are acceptable for use in a laboratory designated for a BSL1 level of containment, and that samples requiring a higher level of containment are excluded from the sector.

The IMCA-CAT **LOM Shop Coordinator** is appointed by the sector Director and is responsible for ensuring that all sector staff, CAT members, and users using the LOM Machine Shop in Building 435 follow the APS Policy and Procedure for LOM Shop Usage. The LOM Shop Coordinator also ensures that all shop equipment is in safe working order, provides training to users qualified to operate shop equipment, maintains a list of qualified machine operators posted in the shop, and recommends repairs for equipment that is deemed to be either unsafe for use, in disrepair, or unusable. The LOM Shop Coordinator will work closely with other LOM Machine Shop coordinators in the building and with the Floor Coordinators.

Appendix A – IMCA-CAT Safety Assignments and ESAF Approvers

Date: 2005 April 04

A.1

IMCA-CAT Safety Assignments

Assignment	Person assigned
Director	Lisa J. Keefe
Safety Coordinator	Anne M. Mulichak
Electrical Safety Coordinator	Kevin Battaile
Chemical Safety Coordinator	Kathleen Favale
Transportation Safety Coordinator	Kathleen Favale
BioSafety Coordinator	Kathleen Favale
LOM Shop Coordinator	Kathleen Favale

A.2

IMCA-CAT Personnel with Experiment Safety Approval Form (ESAF) Authority

As Director of IMCA-CAT, I authorize the following personnel to conduct hazard evaluations of experimental activities, to specify required control measures, and to approve such activities where specified controls have been implemented. Revisions to this form will be forwarded to the APS User Safety Officer.

1. Lisa J. Keefe
2. Kevin Battaile
3. Kathleen Favale
4. Rong Huang
5. Irina Koshelev
6. Anne M. Mulichak

Submitted by: Lisa J. Keefe, Director

[Signature]

[Date]

Appendix B

Standard Procedures Used by IMCA-CAT

IMCA-CAT has evaluated the hazards that will be encountered in its operations and, to mitigate these hazards, the sector staff and its users will follow the unmodified APS Standard Procedures listed below. (Links to these procedures can be found on the APS User Safety web page.)

Date: 2005 April 04

1. The Management of Hazardous Waste
2. APS Technical Update 23: Transportation of Small Quantities of Hazardous Materials
3. Transportation of Hazardous Materials
4. Hand Tool and Portable Power Tool Usage
5. Guideline for Personal Protective Equipment
6. Work Area Demarcation, Warnings and Controls
7. Electrical Safety Work Practices
8. Management of Chemicals
9. Hoisting and Rigging Operations
10. LOM Shop Usage
11. APS User Safety Guide (ANL/APS/TB-23)
12. APS Experiment Hazard Classes

Appendix C

IMCA-CAT Specific Documents and Procedures

IMCA-CAT has evaluated the hazards that will be encountered in its operations and, to mitigate these hazards, the sector staff has developed and will follow the procedures listed below.

Date: 2005 May 12

1. IMCA-CAT Sector Orientation, 2005 April 04
2. IMCA-CAT Biochemistry Laboratory Orientation, 2004 March 04
3. IMCA-CAT Standard Operating Procedure for Derivatization of Macromolecular Crystals with Heavy-atom Reagents, 2005 May 12

Appendix C.1
IMCA-CAT Sector Orientation, 2005 April 04

(See next page.)



Sector Orientation

APS User Administration

- ☐ Complete APS User Orientation and General Employee Radiation Training (GERT)
- ☐ Obtain APS user badge for access to ANL gate and APS building

Safety Policies and Resources

- ☐ Affirm Safety First principle: *Safety of experimenter and others at APS is of central importance and no experiment or operation will be permitted at IMCA-CAT facilities if it is deemed to pose a significant safety risk*
- ☐ Refer to **IMCA-CAT Safety Plan** for environmental, safety, and health information (imca.aps.anl.gov)
- ☐ Contact IMCA-CAT staff regarding any safety-related matters
- ☐ Do not leave personal items unattended

Emergency and Facility Safety

- ☐ Read emergency information on yellow Safety Information board
- ☐ Learn Emergency Medical and Security Phone Number: **911**
- ☐ Learn how to call APS Floor Coordinator: **Pager 2-0101** (*Dial 2-0101, listen to message, enter sector 17 telephone number, press # key and hang up. Coordinator will call back*)
- ☐ Learn Fire Alarm Notification: Continuous ringing = **EVACUATE IMMEDIATELY**
- ☐ Learn Tornado Alert: Loud-speaker tone, followed by directions. *Tornado shelters in LOM restrooms*
- ☐ Locate telephones and phone directories for APS and IMCA-CAT personnel
- ☐ Learn restrictions on working alone
- ☐ Learn about **User Locator** cards
- ☐ Obtain and learn how to use pager
- ☐ Locate nearest Fire Extinguishers (*on every 3rd column around APS ring and at both ends of LOM hallways*)
- ☐ Locate nearby Emergency Exits and egress aisles (*equipment-free zones delineated by yellow tape*)

Sector Safety and Operations

- ☐ Read, understand, and follow regulations in **Guide to the IMCA-CAT Facilities at APS**
- ☐ Learn procedure for obtaining and using cryogenic liquids (*i.e. nitrogen, propane*)
- ☐ Learn procedures for shipping your samples
- ☐ Sign your completed **APS Experiment Safety Approval Form**, verify that it is properly posted on information board and that two copies are given to the floor coordinator on duty
- ☐ Complete **Personnel Safety System (PSS) Training** (*for searching & securing experiment end station*)
- ☐ Complete **Biochemistry Laboratory Orientation** (*on reverse side*)
- ☐ Check if IMCA member company or staff (*Training valid for 2 years*)
- ☐ Check if General User or collaborator and fill out box below (*Training valid for this beamline visit only*)

ESAF Serial No.	17	-	-	<i>I understand that my beam time:</i>
starts at		on		and ends at on

I understand the safety and operational procedures outlined above and agree to operate the beam line and conduct my experiment in a safe manner.

Institution: _____ User's Name: _____

Badge#: _____ Signature: _____ Date: _____

IMCA-CAT Staff Instructor: _____

Appendix C.2

IMCA-CAT Biochemistry Laboratory Orientation, 2004 March 04

(See next page.)



Biochemistry Laboratory Orientation

Emergency and Facility Safety

- ☐ Identify IMCA-CAT Chemical Safety Coordinator, Katie Favale
- ☐ Identify IMCA-CAT Biosafety Coordinator, Katie Favale
- ☐ Read the emergency information posted on the yellow Safety Information board
- ☐ Locate nearest Fire Extinguishers (*at both ends of each LOM hallway*)
- ☐ Locate nearest Emergency Exits
- ☐ Locate telephone and lists of phone numbers
- ☐ Locate safety glasses (*to be worn as work requirements dictate*)
- ☐ Locate Emergency Eyewash
- ☐ Locate Emergency Shower
- ☐ Locate lab coats (*to be worn as work requirements dictate*)
- ☐ Locate gloves and learn proper use (*to be worn as work requirements dictate*)
- ☐ Locate **MSDS (Material Safety Data Sheets)** posted outside laboratory door near APS floor (*Notify IMCA-CAT CAT Coordinator regarding missing MSDS for chemicals with which you will be working. All chemicals and buffers, other than biologically relevant samples, are required to have a MSDS on file.*)
- ☐ Have you brought any radioactive materials? _____ YES _____ NO
- ☐ Have you brought any hazardous chemical materials? _____ YES _____ NO

Introduction to Biochemistry Laboratory

- ☐ Locate chemical fume hood and learn proper operations procedures
- ☐ Locate chemical storage areas (*for acids, bases, flammables, gases, heavy atom compounds, general chemicals*)
- ☐ Read, learn, and follow **IMCA-CAT Standard Operating Procedure for Hazardous Waste Disposal**
- ☐ Read, learn, and follow **IMCA-CAT Standard Operating Procedure for Derivatization of Macromolecular Crystals with Heavy-atom Reagents**
- ☐ Locate purified water
- ☐ Locate microscopes and learn operations procedures (*Instructions are in drawer of microscope tables*)
- ☐ Locate crystal manipulation tools, crystal mounting tools, and dewars
- ☐ Locate laboratory bench work area for your group
- ☐ Label your equipment and supplies so that we can contact you about items you might have left behind (*Label with Name, Institution, phone #, email or IMCA-CAT Exp. Tracking #*)
- ☐ Learn proper labeling of chemicals (*Label with Name, Institution, Date, and Contents*)
- ☐ Learn proper disposal of chemicals
- ☐ Learn that if you choose to store crystals at the IMCA-CAT facility, it is at your own risk
- ☐ Learn labeling protocol for crystal trays to remain at the IMCA-CAT facility (*Label with Name, Institution, Date, and all hazardous materials contents, i.e. heavy atoms*)
- ☐ Learn labeling protocol for crystals to be archived in the IMCA-CAT liquid nitrogen dewar (*Follow instructions posted on the liquid nitrogen archive dewar.*)
- ☐ Locate ice machine

Introduction to Cold Room

- ☐ Locate Emergency Eyewash
- ☐ Locate microscope and learn operations procedures
- ☐ Locate work area for your group

Appendix C.3

IMCA-CAT Standard Operating Procedure for Derivatization of Macromolecular Crystals with Heavy-atom Reagents, 2005 May 12

(See next page.)

Standard Operating Procedure for Derivatization of Macromolecular Crystals with Heavy-atom Reagents

2005 May 12

Introduction

IMCA-CAT authorized staff and users at the IMCA-CAT facility must follow this standard operating procedure for the preparation of heavy-atom derivatives of macromolecular crystals.

Purpose

In order to determine a structure *de novo* using the techniques of macromolecular crystallography, it is necessary to employ either one of two techniques: multiwavelength anomalous diffraction (MAD) or multiple isomorphous replacement (MIR). Some experiments employing MAD and MIR require a method for exposing an already grown macromolecular crystal to a small quantity of a heavy-atom reagent. The purpose of this Standard Operating Procedure is to define a safe and effective procedure for derivatizing macromolecular crystals with heavy-atom reagents.

General Safety Remarks

Most heavy-atom compounds are moderately toxic. The procedure outlined here minimizes the likelihood of exposure to the compound and minimizes generated waste. The IMCA-CAT hood, microscopes, and cold room, all located in the IMCA-CAT Biochemistry Laboratory, are the only locations authorized for use with heavy-atom reagents. All waste generated by this procedure is considered to be hazardous and therefore must be disposed of accordingly. In order to contain the waste, a lab diaper **MUST** be used at all times, except during weighing when the balance may be used without a lab diaper to weigh out solid or liquid heavy-atom reagents. The IMCA-CAT Chemical Safety Coordinator should be consulted for guidance in implementing this procedure, assistance in locating necessary supplies, and instruction in the proper procedure for hazardous waste disposal. Radioactive heavy-atom reagents and compounds are prohibited from use at the IMCA-CAT facilities.

IMCA-CAT staff must be notified in advance of any intent to use heavy-atom reagents.

Please inform your user support staff member or the IMCA-CAT Chemical Safety Coordinator of any intent to use heavy-atom reagents. Notification should be made at least one week in advance of the experiment. Notification should include names of experimenters, dates of experiment, and list of heavy-atom reagents that will be used.

Material Safety Data Sheets must be on file for all heavy-atom compounds to be used.

All heavy-atom reagents transported to or handled at the IMCA-CAT facility must have a Materials Safety Data Sheet (MSDS) on file in the IMCA-CAT MSDS binder. Upon notification of intent to use heavy-atom reagents, the IMCA-CAT Chemical Safety Coordinator will obtain a material safety data sheet (MSDS) for each of the compounds listed for use. This must be done prior to bringing the chemical on site. The user is responsible for reading and understanding the MSDS sections on toxicity and treatment in case of an accident.

Transport and Storage

All heavy-atom compounds are to be stored either in the chemical hood or in a well-ventilated cabinet. Reagents that are to remain at the IMCA-CAT facilities longer than a single visit by a research group will be stored in a limited-access cabinet designated specifically for heavy-atom compounds and reagents. This cabinet is located next to the IMCA-CAT hood. Reagents brought in by users for a single visit to the IMCA-CAT facilities must be transported in a double-container and must be kept in the IMCA-CAT hood. All transport of heavy-atom reagents must be conducted in accordance with ANL Transportation Regulations while on ANL property and with Department of Transportation regulations off of ANL property.

Procedure for Weighing Heavy-Atom Compounds

Wear gloves when handling heavy-atoms and avoid direct contact with the skin. If contact occurs, wash the

contaminated area thoroughly with soap and water. Promptly clean up spills and contact the Chemical Safety Coordinator to determine the appropriate procedure for dealing with a particular compound. To weigh solids, follow this procedure:

1. Tare an appropriately sized container for the amount of solid or solution to be weighed.
2. With gloved hands, open the compound container in a functioning chemical hood and using a clean spatula carefully transfer enough of the solid to the tared vial to meet your requirements.
3. Cap both the bottle and the vial.
4. Wipe the spatula with a Kimwipe.
5. Place the Kimwipe into the hazardous waste disposal container and the spatula in the wash bucket.
5. Reweigh the vial to determine the actual amount of solid present and add water or solvent to dissolve the solid. Store the stock heavy-atom solution in the hood, either in the user-supplied double container or the IMCA-CAT storage cabinet.
6. Dispose gloves into hazardous waste bag.

Procedure for soaking heavy-atom reagents into macromolecular crystals

Soaking heavy-atom reagents into macromolecular crystals is a standard technique for obtaining heavy-atom derivatives of macromolecular crystals. (See reference below.) Typically the preformed crystals are placed in artificial mother liquors containing various concentrations of heavy-atom compounds. In order to keep the volumes of heavy-atom reagent that will be added to the crystal mother liquor small (less than 10% of original droplet volume), relatively high stock concentrations (20 to 50mM or higher) of the heavy atom compounds need to be made. With the crystal sitting in a small drop (~10 μ l) of the artificial mother liquor, a small amount (~0.2 μ l) of the heavy-atom solution is added. The crystal is observed under a microscope for a few minutes to detect signs of disruption to the crystal lattice, such as crystal cracking, loss of birefringence or melting. If there are no signs of disruption to the crystal lattice, then additional aliquots of heavy-atom solution may be added until the final heavy-atom concentration is between typically 2 to 5mM. The crystal may be left undisturbed for a period of time (minutes to days). The crystal may change color, depending upon the compound used. In order to reduce non-specific binding, the crystal may be back-soaked for a period of time (minutes to hours) in heavy-atom-free mother liquor.

Exclusions

Radioactive Samples:

Radioactive substances and radioactive heavy-atom reagents, including ^{32}P , ^{35}S , and ^{125}I , are not permitted at the IMCA-CAT facilities. Reactions involving compounds labeled with these radioactive nuclides should be performed in the users' home laboratories. Crystals already derivatized with these substances are permitted at IMCA-CAT because the level of radioactivity actually contained in the crystal is typically below the levels defined by the Department of Energy set forth in Chapter 5.2, Table 02-3 of the Argonne Environmental, Safety, and Health Manual. IMCA-CAT staff must be informed in advance if such crystals are to be transported to the IMCA-CAT facilities.

Volatile Heavy-Atoms:

Extremely volatile heavy-atom compounds, including dimethyl mercury, tetramethyl lead, and tetraethyl lead, are not permitted at the IMCA-CAT facilities. Reactions involving compounds labeled with these volatile heavy atom compounds should be performed in the users' home laboratories. Crystals already derivatized with these compounds are permitted provided that the total concentration of toxic substance present falls below the maximum allowable levels recommended by APS ES&H. IMCA-CAT staff must be informed in advance if such crystals are to be transported to the IMCA-CAT facilities.

Pathogens:

All pathogenic organisms are prohibited from the IMCA-CAT facilities.

References

Rould, M.A. "Screening for Heavy-Atom Derivatives and Obtaining Accurate Isomorphous Differences" *Methods in Enzymology* Vol 276 Part A: 461-472 (1997) or Blundell, T.L.; Johnson, L.N. "Preparation of Heavy Atom Derivatives" *Protein Crystallography* Chapter 8: 183-239 (1976) and references contained therein for a more thorough discussion of the preparation of heavy-atom derivative crystals.)